5

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/537,042	06/01/2005	Stephan Claude De La Veaux	CH2905USPCT	1319

7590 12/10/2007

Jessica m Sinnott
E I Du Pont De Nemours and Company
Legal- Patents
Wilmingotn, DE 19898

EXAMINER	
YOUNG, NATASHA E	

ART UNIT	PAPER NUMBER
1797	

MAIL DATE	DELIVERY MODE
12/10/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/537,042	DE LA VEAUX ET AL.	
	Examiner	**Art Unit**	
	Natasha Young	1797	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _01 June 2005_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-20_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-20_ is/are rejected.

7)☒ Claim(s) _18-20_ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _01 June 2007_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _10/24/2007_.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification

The disclosure is objected to because of the following informalities: Duplication of the word "chamber" on page 7, lines 3 and 38 and page 9, line 4 and the word "the" on page 12, line 4 should be eliminated.

Appropriate correction is required.

Claim Objections

Claims 18-20 are objected to because of the following informalities: The duplication of the word "chamber" should be deleted on line 23 of claim 18, line 22 of claim 19, and lines 10-11 of claim 20. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-8, 17-18, and 20 are rejected under 35 U.S.C. 102(b) as being anticipated by Anderson (US 3,051,639).

Regarding claim 1, Anderson teaches a reactor for the production of nanoparticles in an aerosol process comprising: (a) a reaction chamber having a wall, an inlet and an outlet the inlet for introducing a hot carrier gas to the reaction chamber which hot carrier gas flows from the inlet through the reaction chamber and out the outlet, (b) a quench zone located downstream of the reaction chamber having an inlet

and an outlet, (c) one or more quench inlets being positioned approximately about the outlet of the reaction chamber for introducing a quench material, (d) one or more reactant inlets positioned between the reaction chamber inlet and the quench inlets for introducing one or more reactants; the reaction chamber comprising: (i) a spacer zone having a length, L.sub.1, extending from the reaction chamber inlet and ending approximately about the reactant inlets and (ii) a homogenization zone having a length L.sub.2 extending from approximately the location of the reactant inlets and ending approximately about the quench zone inlet; the spacer zone for allowing the hot carrier gas to carry the reactants to the homogenization zone, the homogenization zone for contacting the reactants under conditions suitable for forming a reaction product and passing the reaction product to the quench zone, L.sub.1 being sufficient for the hot carrier gas to attach to the wall of the spacer zone of the reaction chamber prior to the reactant inlets and L.sub.2 being sufficient for a residence time of the reactants within the homogenization zone suitable for forming the reaction product which when withdrawn from the outlet of the quench zone is a nanoparticle (see column 1, lines 8-47 and line 71 through column 2, line 21; and figure 1) where the spacer zone is the area of the reactor chamber from where the arc gas enter to the point before the fluid hydrocarbon enters, the homogenization zone is the area of the reactor chamber from the entry of the fluid hydrocarbon until the exit of the product, and the quench zone is element 30.

Claims 2-5 depend on claim1 such that the reasoning used to reject claim 1 will be used to reject the dependent portions of the claims.

Regarding claim 2, Anderson teaches a reactor which further comprises a high temperature heating means for heating the carrier gas selected from the group consisting of a DC plasma arc, RF plasma, electric heating, conductive heating, flame reactor and laser reactor (see column 1, lines 8-27 and line 71 through column 2, line 21).

Regarding claim 3, Anderson teaches a reactor which further comprises a DC plasma arc for heating the carrier gas (see column 1, lines 8-27 and line 71 through column 2, line 21).

Regarding claim 4, Anderson teaches a reactor which further comprises an RF plasma for heating the carrier gas (see figure 1 and column 1, lines 40-48)

Regarding claim 5, Anderson teaches a reactor wherein the reaction chamber further comprises a homogenizer which provides the spacer zone and the homogenization zone (see column 1, lines 8-47 and figure 1) where the spacer zone is the area of the reactor chamber from where the arc gas enter to the point before the fluid hydrocarbon enters, the homogenization zone is the area of the reactor chamber from the entry of the fluid hydrocarbon until the exit of the product, and the quench zone is element 30.

Claims 6-7 depend on claim 5 such that the reasoning used to reject claim 5 will be used to reject the dependent portions of the claims.

Regarding claim 6, Anderson teaches a reactor wherein the homogenizer is constructed of copper or ceramic material (See column 2, lines 27-30).

Regarding claim 7, Anderson teaches a reactor wherein the homogenizer has a wall, an entrance and an exit, the homogenizer wall converging to a nozzle tip at the exit which is spaced a distance L.sub.1+L.sub.2+L.sub.3 from the entrance (see figure 3) the homogenizer begins where the arc gas enters the reactor chamber and ends just before the entry of water at entry 80.

Claim 8 depends on claim 7 such that the reasoning used to reject claim 7 will be used to reject the dependent portions of the claims.

Regarding claim 8, Anderson teaches a reactor in which the distance L.sub.3 is zero (see figure 3) the homogenizer begins where the arc gas enters the reactor chamber and ends just before the entry of water at entry 80.

Regarding claim 17, Anderson teaches a reaction chamber for minimizing flow recirculation in a reactor, the reaction chamber comprising a wall, an entrance and an exit wherein, in the vicinity of the exit, the wall of the homogenizer converges to a nozzle tip from which a reaction product can be withdrawn, a hot carrier gas inlet located about the entrance of the reaction chamber and quench material inlets located about the exit of the reaction chamber and one or more reactant inlets located between the hot carrier gas inlet and the quench inlets, the homogenizer having (i) a spacer zone having a length, L.sub.1, extending from the reaction chamber entrance and ending about the reactant inlets and (ii) a homogenization zone having a length L.sub.2 extending from the reactant inlets to a position downstream of the quench inlets for contacting the hot carrier gas and the reactants and wherein L.sub.1 of the spacer zone is sufficient for the hot carrier gas to attach to the wall of the reaction chamber before

the hot carrier gas reaches the reactant inlets and L.sub.2 of the reaction chamber being sufficient for a residence time within the homogenization zone suitable for forming the reaction product (see column 1, lines 8-47 and line 71 through column 2, line 21; and figure 1) where the spacer zone is the area of the reactor chamber from where the arc gas enter to the point before the fluid hydrocarbon enters, the homogenization zone is the area of the reactor chamber from the entry of the fluid hydrocarbon until the exit of the product, and the quench zone is element 30.

Regarding claim 18, Anderson teaches a reactor for the production of nanoparticles from an aerosol process comprising: (a) a reactor chamber having axially spaced inlet and outlet ends along the reactor axis wherein positioned at the inlet end of the reactor chamber is a high temperature heating means to heat a carrier gas having a flow direction axially from the reaction chamber inlet downstream through the reaction chamber and out the chamber outlet and wherein one or more quench gas inlets are positioned up stream from the outlet end of the reactor chamber for introducing a quench gas for cooling; (b) a reaction chamber having an axially spaced entrance and an exit wherein in the vicinity of the exit, the homogenizer converges to a nozzle tip, the entrance of the homogenizer being aligned with the inlet to the reaction chamber and the homogenizer being inserted within the reaction chamber and held in place by a homogenizer holder such that the homogenizer extends from the inlet end of the reaction chamber securely fitting against the inlet end for at least a portion of the homogenizer's overall length and wherein the homogenizer comprising two zones: (i) a spacer zone having a length, L.sub.1, extending from the reaction chamber entrance

and ending where one or more reactant inlet tubes are positioned, after having passed through a wall of the reaction chamber, to deliver one or more reactants into the reaction chamber so the reactants contact the hot carrier gas and (ii) a homogenization zone extending from the reactant inlet tubes' location to a position down stream of the quench gas inlets; and wherein carrier gas and reactants mix and react in the homogenization zone and pass through the flow homogenization exit nozzle to enter a quench zone of the reaction chamber defined by the quench gas inlet location in a reaction chamber wall and the reaction chamber outlet and wherein L.sub.1 of the spacer zone must be long enough to have the hot gas flow attached to walls of the reaction chamber before the hot gas reaches the reactant inlets and the overall length (L.sub.1+L.sub.2) of the reaction chamber is designed to a residence time sufficient that the following three tasks are completed before gas flow exiting the homogenizer: (1) gas flow in the reaction chamber has achieved a near one-dimensional flow and concentration profile; and (2) gas-phase nucleation of product particles has been initiated (see column 1, lines 8-47 and line 71 through column 2, line 21; and figures 1 and 3) where the spacer zone is the area of the reactor chamber from where the arc gas enter to the point before the fluid hydrocarbon enters, the homogenization zone is the area of the reactor chamber from the entry of the fluid hydrocarbon until the exit of the product, the homogenizer begins where the arc gas enters the reactor chamber and ends just before the entry of water at entry 80, and the quench zone is element 30.

Regarding claim 20, Anderson teaches a reaction chamber for minimizing flow recirculation in a reactor, the reaction chamber comprising an axially spaced entrance

and an exit wherein in the vicinity of the exit the homogenizer converges to nozzle tip, the entrance of the homogenizer being aligned with the inlet to the reaction chamber and the homogenizer being inserted within the reaction chamber and held in place by a homogenizer holder such that the homogenizer extends from the inlet end of the reaction chamber securely fitting against the inlet end for at least a portion of the homogenizer's overall length and wherein the homogenizer comprising two zones: (i) a spacer zone having a length, L.sub.1, extending from the reaction chamber entrance and ending where one or more reactant inlet tubes are positioned, after having passed through a wall of the reaction chamber, to deliver one or more reactants into the reaction chamber so the reactants contact the hot carrier gas and (ii) a homogenization zone extending from the reactant inlet tubes' location to a position down stream of the quench gas inlets; and wherein carrier gas and reactants mix and react in the homogenization zone and pass through the flow homogenization exit nozzle wherein L.sub.1 of the spacer zone must be long enough to have the hot gas flow attached to walls of the reaction chamber before the hot gas reaches the reactant inlets and the overall length (L.sub.1+L.sub.2) of the reaction chamber is designed to a residence time sufficient that before gas flow exits the homogenizer: gas flow in the reaction chamber has achieved a near one-dimensional flow and concentration profile (see column 1, lines 8-47 and line 71 through column 2, line 21; and figures 1 and 3) where the spacer zone is the area of the reactor chamber from where the arc gas enter to the point before the fluid hydrocarbon enters, the homogenization zone is the area of the reactor chamber from the entry of the fluid hydrocarbon until the exit of the product, the

homogenizer begins where the arc gas enters the reactor chamber and ends just before the entry of water at entry 80, and the quench zone is element 30.

Claim 9 rejected under 35 U.S.C. 102(b) as being anticipated by Detering et al (US 5,935,295).

Regarding claim 9, Detering et al teaches an aerosol process for producing nanosize particles, comprising: (a) introducing a hot carrier gas into an aerosol reactor, the aerosol reactor comprising a reaction chamber and a quench zone having an inlet and an outlet, the reaction chamber having a wall, a carrier gas inlet and an outlet, one or more quench material inlets being positioned approximately about the outlet of the reaction chamber, one or more reactant inlets positioned between the carrier gas inlet and the quench material inlets; the reaction chamber having: (i) a spacer zone having a length, L.sub.1, extending from the reaction chamber inlet and ending approximately about the reactant inlets and (ii) a homogenization zone having a length L.sub.2 extending from approximately the location of the reactant inlets and ending approximately about the quench zone inlet; wherein the hot carrier gas is introduced to the reaction chamber at the carrier gas inlet, the hot carrier gas flowing through the reaction chamber and out the outlet into the quench zone; (b) introducing one or more reactants into the reaction chamber at the reactant inlets, the reactants contacting the hot carrier gas in the spacer zone and passing to the homogenization zone to form a reaction product, L.sub.1 being sufficient for the hot carrier gas to attach to the wall of the spacer zone of the reaction chamber prior to the reactant inlets and L.sub.2 being sufficient for a residence time of the reactants within the homogenization zone suitable

for forming the reaction product; (c) passing the reaction product to the quench zone; and (d) withdrawing from the outlet of the quench zone a nanoparticle reaction product (see Abstract; figure 1; and column 4, line 66 through column 5, line 67) where the spacer zone starts where plasma gas enters the reactor chamber at element 31 and ends before the entry of the reactants at element 32 and the homogenization zone start where the reactants enters at element 32 and ends as the quenching zone, element 26, begins.

Claims 10 and 12-16 depend on claim 9 such that the reasoning used to reject claim 9 will be used to reject the dependent portions of the claim.

Regarding claim 10, Detering et al teaches a process wherein the reactants are TiCl.sub.4 and O.sub.2 and the product is TiO.sub.2 particles (see Table 3 and column 21, lines 26-34).

Regarding claim 12, Detering et al teaches a process wherein the carrier gas is inert (see column 7, lines 23-30).

Regarding claim 13, Detering et al teaches a process wherein the carrier gas is selected from the group consisting of argon, oxygen, nitrogen, and a combination thereof (see column 7, lines 8-30 and Table 3).

Regarding claim 14, Detering et al teaches a process wherein the reactants are one or more precursor materials (see Table 3).

Regarding claim 15, Detering et al teaches a process wherein the reactants are in the vapor, liquid, emulsion, dispersion, solution or powder form (see column 7, lines 37-42).

Regarding claim 16, Detering et al teaches a process wherein the carrier gas is introduced to the reaction chamber so that it has a flow direction axially from the chamber inlet downstream through the reaction chamber (see figure 1).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Detering et al (US 5,935,293).

Claim 11 depends on claim 10 such that the reasoning used to reject claim 10 will be used to reject the dependent portions of the claim.

Regarding claim 11, Detering et al teaches titanium dioxide particles having a particle size of between 10 nm and 100 nm (see Table 3 and column 21, lines 26-34).

Detering et al does not teach the particle having a BET surface area of more than 10 m.sup.2/g.

When there is a design need or market pressure to solve a problem (**controlled synthesis of nanosize particles**) and there are a finite number of identified, predictable solutions (**ultrafine particle size range of less than 500, preferably 10-100 nanometers**), a person of ordinary skill has good reason to pursue the known options (**ultraffine particle size range of 10-100 nanometers with a BET surface area of more than 10 m.sup.2/g**) within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

Claim 19 rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson (US 3,051,639).

Regarding claim 19, Anderson teaches an aerosol process for producing nanosize particles, comprising the steps: (a) introducing a carrier gas into a reactor chamber having (i) axially spaced inlet and outlet ends along the reactor axis wherein positioned at the inlet end of the reactor chamber is a high temperature heating means

to heat a carrier gas having a flow direction axially from the reaction chamber inlet downstream through the reaction chamber and out the chamber outlet and wherein one or more quench gas inlets are positioned up stream from the outlet end of the reactor chamber for introducing a quench gas for cooling; and (ii) a reaction chamber having an axially spaced entrance and an exit wherein in the vicinity of the exit, the homogenizer converges to nozzle tip, and wherein the homogenizer comprising two zones: (i) a spacer zone having a length, L.sub.1, extending from the reaction chamber entrance and ending where one or more reactant inlet tubes are positioned, after having passed through a wall of the reaction chamber, to deliver one or more reactants into the reaction chamber so the reactants contact the hot carrier gas and (ii) a homogenization zone extending from the reactant inlet tubes' location to a position down stream of the quench gas inlets; and wherein carrier gas and reactants mix and react in the homogenization zone and pass through the flow homogenization exit nozzle to enter a quench zone of the reaction chamber defined by the quench gas inlet location in a reaction chamber wall and the reaction chamber outlet and wherein L.sub.1 of the spacer zone must be long enough to have the hot gas flow attached to walls of the reaction chamber before the hot gas reaches the reactant inlets and the overall length (L.sub.1+L.sub.2) of the reaction chamber is designed to a residence time sufficient that the following three tasks are completed before gas flow exiting the homogenizer: (1) gas flow in the reaction chamber has achieved a near one-dimensional flow and concentration profile; and (2) gas-phase nucleation of product particles has been initiated; (b) heating the carrier gas by thermal contact with the heating means to a

temperature to initiate reaction of the carrier gas with one or more reactants; (c) introducing one or more reactants through the reactant inlet tubes to form a reaction mixture; (d) adjusting flow rates of the carrier gas and reactants such that reaction mixture flows through the flow homogenization chamber at a rate such that (1) flow of the reaction mixture is characterized by one-dimensional flow and a one-dimensional concentration profile; and (2) gas-phase nucleation of the product has been initiated; (e) immediately injecting quench gas through the quench gas inlet tubes as the reaction mixture flow enters the quench zone so that particle coagulation and coalescences is reduced and temperature of the reaction mixture and product is decreased; and (f) separating and collecting the product (see column 1, lines 8-47 and line 71 through column 3, line 40; column 4, lines 30-60; and figures 1 and 3) where the spacer zone is the area of the reactor chamber from where the arc gas enter to the point before the fluid hydrocarbon enters, the homogenization zone is the area of the reactor chamber from the entry of the fluid hydrocarbon until the exit of the product, the homogenizer begins where the arc gas enters the reactor chamber and ends just before the entry of water at entry 80, and the quench zone is element 30.

Anderson does not teach the homogenizer entrance being aligned with the inlet to the reaction chamber and the homogenizer being inserted within the reaction chamber and held in place by a homogenizer holder such that the homogenizer extends from the inlet end of the reaction chamber securely fitting against the inlet end for at least a portion of the homogenizer's overall length.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to make the homogenizer separable from the reactor chamber, since it has been held that constructing a formerly integral structure in various elements involves only routine skill in the art.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Natasha Young whose telephone number is 571-270-3163. The examiner can normally be reached on Mon-Thurs 7:30am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Walter Griffin can be reached on 571-272-1447. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

NY

Walter D. Griffin
WALTER D. GRIFFIN
SUPERVISORY PATENT EXAMINER